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INSECTS ON AFRICAN OIL-PALMS.

By B. A. R. Gater.

SEVERAL enquiries have been received regarding the possibilities of damage to African oil-palms (*Elaeis guineensis*, Jacq.) by insects, and it is considered that although investigations on the insects affecting this crop are only in the preliminary stages, a few notes on the subject would be of interest to planters. This article must be regarded purely as a progress report, and in no way as a comprehensive statement on matters which require to be much more fully investigated before definite conclusions can be arrived at.

In general it may be stated that the pests of oil-palms are much the same as those of coconuts, and some authors, in discussing the pests of various crops, collect all the pests of palms grown for ornament or profit under one heading. In addition to coconut pests which have been found attacking the oil-palm there are, however, several which have been found only on the latter, which, owing to differences in the two palms, may have a special significance from the economic point of view.

It is proposed here to deal with the insects concerned under three headings, covering those reported from other countries where oil-palms are grown, those recorded in Malaya, and a few words about the insect visitors to the flowers. The first class is especially important in the case of a comparatively new crop, owing to the danger of the accidental introduction of insects which are known to be injurious in other countries. In the case of one insect (*Pachymerus nucleorum*) which damages the nut in British Guiana, Dr. Leefmans records that out of a parcel of twenty-five seeds of *Attalea* palms received in Java twenty-four were attacked, and he immediately issued a warning to planters of the danger of introducing an insect of this type. The seeds, moreover, appeared to be quite sound externally, emphasising the ease with which injurious insects can be imported unless the material is submitted to expert examination. In discussing the pests of a particular crop, therefore, one of the first essentials is to obtain as accurate information as possible about the existing pests elsewhere which, if imported, would be capable of causing the most serious damage.

Pests in other Countries.

Apart from coconut pests such as Rhinoceros beetles (*Oryctes* spp.) and Palm weevils (*Rhynchophorus* spp.) which have been recorded as attacking oil-palms wherever they are grown, the particular species of these insects varying with the country, there appear to be two insects of outstanding importance, one of which attacks the nuts and has been mentioned above, the other attacking the leaves.

Pachymerus nucleorum, F. (Bruchidae) The adult beetle is about a centimetre in length, stout in appearance and greyish brown in colour. The head is bent down and is situated on a distinct, rounded "neck" and bears rather long antennae.* According to Bondar the adult is nocturnal with a total life of about a month. Eggs are laid at the base of the nut, fifteen to twenty being produced by one female. The grub, which is curved, legless, and about a centimetre and a half in length when full-grown, bores into the nut through the sap-channels and feeds for two and a half months. The pupal stage is three weeks, but the newly emerged beetle remains within the nut for another week before making its way to the exterior.

Nuts are said not to be attacked while on the palms unless the latter are sickly or injured, but fallen nuts are always infested, to the extent, sometimes, of 70%. Supplies for one factory mentioned by Bondar were infested to the extent of 33%. In addition to the African oil-palm this insect has also been found in the seeds of the following palms:—*Bactris major*, Jacq. *Maximiliana regia*, Mart., *Attalea cohune*, Mart and *A spectabilis*, Mart. It has been reported on oil-palms in British Guiana and Brazil.

Coelaemenodera elaeidis, Maulik. (Hispinae) The grubs of this beetle attack the foliage of oil-palms in the Gold Coast, probably in much the same way as *Promecotheca cumingi* attacks coconut leaves in this country. The Government Entomologist in the Gold Coast (W. H. Patterson) in his report for 1919 states:—"It has been reported that on one large concession the trees had fully 50% of their foliage destroyed: and that ....thousands of trees were without green leaves. Whilst some crop was obtained, there was a marked decrease in the size of the bunches and individual fruits, which had a thinner pericarp and therefore less oil".

The beetle is a typical hispid and is between four and six millimetres in length. It is pale yellow in colour, the wing cases being reddish except on the basal and apical areas. The grub is creamy white and measures about five millimetres in length when fully grown; the prothoracic segment being considerably expanded laterally, with the expansions rounded (S Maulik, Bull. Ento. Res. x p. 171.)

Apart from these two, no serious attacks by insects other than *Oryctes* and *Rhynchophorus* have been recorded, as far as can be

* The rough description given is from Dr. Leefmans' description in Meded: Lab, v. Plantenziekten No. 37, which is of *Pachymerus* sp. probably *nucleorum*. I have no description of *P. nucleorum*, F.

ascertained from the literature available. Two scale insects (Coccidae) which occur in this country have, however, been recorded on oil-palms in the Seychelles, *Aspidiotus destructor*, Sign. and *Ischnaspis filiformis*, Dougl. The former is the cause of the extensive yellowing of coconut leaves seen on some coconut estates here, while the latter, although not so far reported to have done much damage in Malaya, was imported into the Seychelles and the oil-palm plantations became badly infested within a few years.

In the Dutch East Indies a number of pests of more or less importance has been reported from time to time. A small scolytid beetle, *Xyleborus morstatti*, Hgd. bores into the ribs of the leaves, while caterpillars of the pyralid moth, *Mucialla rufovenalis*, Sn., attack the flowers and young fruits of oil-palm as well as coconut. The maggots of certain flies have been recorded as damaging the unopened leaves. Among leaf-eating insects the caterpillars of the nymphalid butterflies *Discophora celinde*, Stoll. and *Hypolimnas misippus*, L., of the limacodid moth *Orthocraspeda trima*, Moore, and of the psychid moth *Lansdownia bifenestralis*, Snell., may be mentioned.

Insects recorded in Malaya.

Rhinoceros beetle (*Oryctes rhinoceros*, L.) This is the same insect which attacks coconuts and is too well known by planters to require description. On oil-palm estates attention should be paid to the masses of refuse from the factory, which form likely breeding places on the estate itself.

Red-stripe weevil (*Rhynchophorus schach*, Oliv.) Another well-known coconut pest which also attacks oil-palms. It would be well to remember that it has been shown that the female will not lay eggs in undamaged palm tissues, and that if eggs are laid in cut petioles the grubs can bore their way down into the stem, instances having been observed where grubs went through thirty-six inches of petiole into the stem. (G. H. Corbett, Bull. 36. Dept: Agric: F. M. S.). One of the main methods of controlling this insect is to keep down the Rhinoceros beetle, whose borings in the crown are utilised by the Red-stripe weevil. This insect appears to prefer sago and "Nibong" (*Oncosperma tigillaria*, Hort.) to other palms for breeding purposes.

The above insects are serious pests, and as great care should be taken to prevent them spreading on oil-palm as on coconut estates, special attention being paid to the ends of petioles when the palms are pruned to prevent the entry of the Red-stripe weevil.

Other insects. Among other pests recorded on this crop two appear likely to cause serious injury to the leaves locally, considerable damage being done on coconuts, especially young palms, when outbreaks occur. These are the Nettle caterpillar, *Setora nitens*, Wlk. and the Coconut caseworm, *Mahasena* sp. Both may be found in small numbers on both oil and coconut palms, but they occasionally escape from the control exerted by their parasites and increase to large numbers. This generally occurs on young palms, but they can be controlled by a lead

arsenate spray. Other insects found damaging the leaves are the caterpillars of the nymphalid butterfly, *Amathusia phidippus*, L. and the melolonthid beetle, *Anomala dorsalis*, F., both of minor importance. The aphid, *Oregma nipae*, de Goot, has been found on the leaves sucking the plant juices, but is also of minor importance at present. A lucanid beetle has been reported to damage the leaves, but this has not been confirmed, and dipterous larvae have been found in unopened leaves. Whether the latter are primary or whether they are associated with a fungoid disease is as yet uncertain.

At the end of last year the caterpillars of an as yet undetermined lymantriid were found gnawing the female flowers and young nuts, and in a few instances were observed, in the laboratory, partially to penetrate the flowers. The insects failed to breed in captivity but a female laid fifty-three infertile eggs. The pupal period was 4 to 6 days. The male appears to be similar to the description of *Orgyia turbata*, Btlr, but is smaller, having a wing expanse of 12 m/m only. The female is wingless, brown in colour with a whitish anal tuft; length (spirit specimen) 7 m/m. The caterpillar is brown with two long tufts of spatulate hairs directed forward from the 1st. segment, a tuft of spatulate hairs on the 11th, and four small tufts of plumescent hairs on the 12th; small lateral tufts along the body and short thick brushes of yellow hairs on segments 4 to 7. Short tufts of spatulate hairs arise from the centre of the dorsal tuft on 4 and sometimes on 5 as well; length 9 m/m.

It is unknown to what extent this insect may develop as a pest of oil-palm fruits, but the damage done to the cluster on which the caterpillars were found was considerable. It does not appear to be very widely distributed, having been found in one locality only, but a watch should be kept for it on other estates.

In addition to the above the larvae of a tineid moth were found in large numbers in the male flowers. The pollen had, however, already been shed and for the present it is concluded that this insect is a refuse-feeder and not a pest.

Status of Recorded Pests.

Although the list of insects which have been found damaging the oil-palm in Malaya comprises eight species, including four species which seriously attack coconuts, none has so far caused any serious damage on oil-palm estates in this country. The list of insect pests in West Africa is a small one, and nowhere does the crop appear to have suffered from the attacks of insects in a way comparable to coconuts.

As pointed out by Dr. Rutgers*, however, the oil-palm in West Africa, being scattered among other plants, grows under vastly different conditions to the planted areas in Sumatra and Malaya. This

* "Investigations on Oil-palms" published by the Experimental Station A. V. R. O. S. Medan, 1922, Chapter 7.

produces a more favourable set of conditions for the palms from the point of view of insect attack, and there is no doubt that under plantation conditions they will suffer more than in their natural habitat. The list of injurious insects in Sumatra has already exceeded that in the oil-palm belt in West Africa, although the first planted areas in Sumatra only date back to 1911.

At present it appears that the insects attacking both palms have a preference for the coconut, and this is probably the reason why the Rhinoceros beetle and the Red-stripe weevil have not harmed oil-palms in Malaya to any extent. Dr. Rutgers (*ibid*) mentions a case where the Rhinoceros beetle attacked some oil-palms in Sumatra, doing comparatively little damage, but a block of coconuts 200 metres distant was so severely damaged that several died as a result of the attack.

For the moment then, it may be stated that no serious damage by insects occurs on this crop, but the fact that insects dangerous to coconuts have been found injuring the oil-palm emphasises the necessity for keeping a careful watch for pests on all estates.

Two possible sources of danger should be considered ;—

1. The adaption of local insects, especially those which damage coconuts, to the oil-palm.
2. The importation of insects likely to attack oil-palms.

Of these the first has been shortly discussed above, but the danger from the second source cannot be over-estimated. The worst pests in any country are the result of imported insects, and great caution is therefore required in bringing seeds or other portions of the oil-palm into Malaya. It should never, in fact, be done without the co-operation of some competent authority, and even then it sometimes happens that insects, escaping all preventive and precautionary measures, obtain an entry and establish themselves as pests of the first magnitude in a new country.

Pollination.

The question of the pollination of the oil-palm by insects has been raised owing to the necessity of hand pollinating the flowers. Hand pollination is the practice followed on estates during the early stages of the palm's growth, but according to planters with extensive experience of oil-palms artificial pollination becomes unnecessary when the palms have reached a certain height, the palms being then sufficiently exposed to enable air currents to carry the pollen. Moreover, practical growers state that continued hand pollination, ensuring as it does the fertilisation of a large percentage of female flowers, is injurious to the palm, since too many fruits are set to enable the palm to retain its full vitality. On the other hand it has been shown that very poor yields are obtained where hand pollination is not done, and it is stated that for a proper return this operation is a necessity. The extent to which artificial pollination is necessary does not come within the scope of this article, but the fact that it has to be resorted

to, whether for a limited time or throughout the productive period of the palms, has led to enquiries as to whether or not the propagation of insects, such as bees, would relieve planters of the necessity of pollinating the flowers by artificial means.

In nature it is assumed that pollination is effected by wind and insects, and Bücher and Fickendey, writing of conditions obtaining in Africa, state that wind is the most important agent Chevalier has stated that pollination in Africa is brought about by a small weevil which is found on the male and female flowers, but it was found by Beccari that this weevil lays its eggs in the male and sometimes in the female flowers, the grubs subsequently destroying the buds. Rutgers states that in Sumatra a few bees have been seen collecting pollen.

The literature on the subject of the pollination of the oil-palm is so scanty that no idea can be formed as to whether or not pollination by insects is an important factor in the fruiting of oil-palms in nature. When a crop is introduced into a new country it is very frequently found that little or no fruit is formed owing to the absence, in the new country, of the particular insect which is responsible for carrying the pollen in the plant's natural habitat, and since in the case of the oil-palm there is no information on the subject as far as the writer has been able to ascertain, we are completely in the dark as to what occurs under natural conditions.

When a plant fails to set fruit in new surroundings it is possible, by a study of its insect visitors in its original home, to import the insect which is found to be the most useful vector. With regard to the weevil (*Derelomus*) mentioned by Chevalier it would, of course, be extremely dangerous to import it owing to its habit of destroying the flowers: no insect should be imported until the fullest investigation had been made into its intimate life-history. Even in the case of parasites on injurious insects, the introduction is accompanied by grave risks unless every possible detail is first examined, owing to the habit of some insects of not only parasitising an injurious insect, but of attacking at the same time other insects which are actually beneficial, thus nullifying the object of their introduction and sometimes even causing considerable harm by reducing other beneficial insects, thereby allowing injurious pests to increase. The introduction of any insect for beneficial purposes must be carefully examined from a critical point of view, and the necessary life-history studies can only be done on the spot.

In order to find out what influence, if any, insects had as vectors of oil-palm pollen in Malaya, nineteen flowering palms were kept under observation and daily collections made of the insects found on the male and female flowers. Over 1400 insects were collected in this manner, an interim statement of those collected up to the end of last year having been included in the annual report of the Entomological Laboratory for 1924. The fact that an insect visits a flower does not necessarily mean that it effects pollination, and the present results are of visits only. On the surface, however, it it is evident that they have little influence (at any rate for certain periods of the year)

on pollination owing to the fact that an overwhelming majority was taken on the male flowers, thus showing that although insects visit the oil-palm in considerable numbers they do not make an adequate return for what they take from the plant. The fact that only a few were found visiting the female flowers seems rather curious in view of the smell of anise which emanates from flowers of both sexes, and which would presumably be attractive to certain insects. In addition the visitors appear to vary somewhat with the time of year, doubtless due to an alteration in the abundance of other food. Various species of Dermaptera, mostly *Chelisoches morio*, *F.*, Coleoptera, Diptera and Hymenoptera were included in the collection, but so far as could be seen only the members of the family Apidae occurred with a regularity sufficient to be of any possible use as pollinators. The following table gives the number of members of this family caught on the male and female flowers :—

Insect.	Caught on :— ♂	♀	Percentage of Total No.
Apis florea ...	152	10	11.3
„ *indica* ...	212	7	15.6
„ *dorsata* ...	278	45	22.6
Melipona spp. ...	545	2	38.3
Other insects ...	175	—	12.2
Total ...	1,362	64 = 1,426	

The figures indicate that although several species of bees are frequent visitors to the oil-palm, their object is the collection of pollen rather than nectar. Little can be said on the subject of the relative frequency of visits by any one species, since this depends on the number of colonies in the locality; the same experiment repeated elsewhere would be certain to give different data. The principal point brought out is that it appears to be the pollen which is the attraction, and that out of 1426 insects only four and one half per cent. visited the female flowers. It will be seen that there is no scarcity of certain bees, so that any pollination which they perform will be effected naturally in this country, but proof is needed as to whether the visitors to the female flowers actually bring about fertilisation, and more observations are needed over a wide area before accurate data will be available.

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SOME OBSERVATIONS ON TAPPING OF HEVEA.

By W. N. C. Belgrave.

FOUR years ago observations were started on a limited number of trees in different localities with a view to studying the behaviour of individuals to be used subsequently as material for physiological experiments. Some of the observations may be of general interest and are here described.

The experimental plots were :—

Plot A.—A plot of 50 trees, sixteen years old, on very gently sloping land at Castlefield Estate,* Selangor. There were 43 trees per acre when observation commenced. The tapping system was and had been for some time, a V cut on half the circumference tapped on alternate days.

Plot B.—A similar plot to A, at Castlefield on flat land. The trees on both plots A and B were remarkably healthy in appearance and bark renewal was excellent.

Plot C.—A plot of 75 untapped eight year old trees at Batu Tiga Experimental Plantation. The soil was a heavy, very acid clay, liable to frequent flooding, and the trees were stunted, with thin bark and sparse, unhealthy looking foliage.

Plot D.—A plot of 100 sixteen year old trees at the Experimental Plantation, Kuala Lumpur widely planted on steeply sloping land. The field has never been thinned.

Plots E. F & G.—Three adjacent plots of 60 trees each, grown under similar conditions, situated on both sides of a steeply sloping ravine. The trees are fifteen years old and have never been thinned-out, having purposely been allowed to become overcrowded. They are on the whole poorly developed, with hard, stony bark.

Plot H.—A plot of 1000 trees, 15.4 acres in extent, fourteen years old at Castlefield Estate, on nearly flat land.

Tapping and Collection.

Except on plots A, B & H all cuts were started 30" above ground level. Tapping was carried out as part of the usual routine of the plantation and the particular days selected for record-making were never known beforehand to the tappers.

When determinations of dry rubber were made, the latex was rapidly coagulated in the cups by addition of a few ccs of a dilute solution of calcium chloride and acetic or hydrochloric acid—the resulting pads of rubber were marked and brought to the laboratory, creped in the usual manner, air-dried and weighed to the nearest gram.

*The writer desires to express his best thanks to Mr. D. S. Gardner, Manager of Castlefield Estate, for permission to make observations, and for help freely given on this as on many other occasions.

Constancy of Yield.

For the first few months, observations on plots A, B, D & F, were made weekly, but it was soon found that intervals of a fortnight could safely be allowed—and these were subsequently extended to a month or more between collections. This was possible as, after the initial period of opening up and establishing latex flow had passed, the order of merit of the trees on any one plot was remarkably constant. Although the period of these observations is not nearly long enough to prove or disprove the oft-quoted dictum that "good yielders remain good yielders"—it is sufficiently long to confirm some recent views that for thinning-out, or selection, elaborate records are unnecessary. For practical purpose, the rough method already in use on many Estates is sufficient—viz. an inspection made twice or three times a year (excluding the wintering season) and the trees marked A, B or C according as the cups show a yield above the average, or below average.

The well known effect of disease in influencing yield must, of course, be borne in mind in such observations.

Initial and Subsequent Yield.

Observations were made on plots C, D, E, F & G, on the extent to which yield on first opening may be used as an index to subsequent yield.

On plot C, which gave a poor yield throughout, no connection could be traced between initial and subsequent yields. On the other plots, the highest and lowest yielders gave marked indications of their capacities, but no differentiation between the majority of trees, the average yielders, could be made.

It should be understood that the trees observed were more than eight years old; it is not suggested that relatively high or low yielders can be picked out in this way on young areas, nor indeed is it suggested that the observation is of general application to older areas.

Effect of Exposure on Yield.

As it seemed not impossible that the temperature of the tissues below the tapping cut might influence yield, observations were made on plots A and B—where simultaneous change over was not in force—of the effect on yield of changes of tapping surfaces from the sides of the tree facing the morning sun to those not so exposed, and vice versa.

No changes which could be attributed to this factor have been noted.

Reaction of Latex.

Observations were made on plots A, C, F & G on the reaction of the latex as it flowed from the trees. On plots A & C litimus paper was used, and on F & G methyl red and diethyl red. Of all the trees, only four gave markedly acid latex, and were very poor yielders. On the other hand many equally poor yielders gave latex

of the average pH value, and no relationship between reaction and yield could be traced.

In many cases it was noted that the partly coagulated latex on tapping cuts at the end of the period of flow was markedly acid, while the latex in the cup was still nearly neutral. This naturally suggested the cessation of flow might be related to increased acidity, but experiments in which a faintly alkaline solution was kept running slowly along the cut gave no positive evidence of increased yield.

Viscosity.

Rough determinations of viscosity were made in the field with a pipette. No close relationship could be established but many poor yielders gave very viscous latex, often of high dry rubber content, while no very high yielder gave latex of high viscosity.

Acid-containing Cells.

In 1923 attempts were made to relate the position of cells with strongly acid cell-sap (subsequently described by Bobilioff) vis à vis the latex vessels, and yield, as it seemed not impossible that the withdrawal of fluid on tapping might lead to excretion of acid into the vessels.

No relationship could be traced.

Girth.

Although the number of trees and plots is too small for far reaching conclusions to be drawn from the application of statistical methods, such an application is not without interest.

Applying the usual methods to plots A and F, both tapped on half the circumference alternate daily, the following figures are obtained :—

TABLE I.

	Plot A 46 trees and 21 collections.	Plot F. 60 trees 20 collections.
Mean yield in grams dry rubber	31.7 ± 1.2	21.4 ± 1.1
Standard deviation of yield	13.2 ± .9	11.6 ± .75
Coeffn. of variability of yield	41.5	54.2
Mean girth in cms. at 30 cms. above ground level	187 ± 3.0	116 ± 2.6
Standard deviation of girth	32.8 ± 2.3	28.2 ± 1.8
Coeffn. of variability of girth	17.5	24.3
Coeffn. of correlation between yield and girth	.39 ± .08	.55 ± .06

The careful and extensive work of Whitby[1] and La Rue[2], in the F.M.S. and Sumatra respectively gave lower figures for correlation viz : –

Whitby—1011 trees, seven years old 0.260 ± 0.020

La Rue—949 ,, eight ,, 0.299 ± 0.019

Both figures indicate a positive relationship, but one much too small to be, in itself, of practical value.

In view of these two studies it is surprising to find the idea gaining ground in the F.M.S. that yield is closely related to girth, and that girth might be used as a measure of yielding capacity. It is suggested that this view is based on two recent publications, one in the Bulletin of the Rubber Growers' Association,[3] giving a summary results of experimental tapping, the other the work of Bryce & Gadd in Bulletins of the Department of Agriculture Ceylon. (Nos. 55 and 68).

In the former, it is stated :—

"The correlation between the girth and number of latex vessel "rings is so close that for selection purposes the authors consider that "it is sufficient to take the girth measurement at 20 inches from the "ground."

In the latter (Bulletin No. 55 p.41) under Summary—there is "(12) Where selected seed is used, the character girth can be "used as a basis on which to select trees for thinning."

It is to be feared that not all readers realise that the implication of the R.G.A. workers that latex ring development may be used, alone, for selection is by no means proved, and in fact meets with dissent from those who have done most work on the subject e. g. La Rue (loc. cit 581) and Bryce & Gadd (loc. cit Bull. No 68 p. 62).

The proviso of the second quotation is all important; the authors were recording yields from the seedling offspring of *one* female parent, obviously great caution is necessary in applying this result to mixed plantations. This need for caution was clearly stated by Bryce & Gadd, but appear to have been overlooked by some readers.

To revert to the R.G.A. summary, it is unfortunate that curves should have been used to represent the relationships investigated—as is well known (c.f. Bryce & Gadd Bull. No. 68 p 57) they are unsuited for this purpose—particularly when the values, taken as ordinates and abscissae are the means of group values, as opposed to individual figures. To make this point clearer the data from plots A and F may be arranged as follows:—

1. Whitby—Variation in Hevea bras : Ann. of Bot. *33*, 313, 1919.
2. La Rue—Structure and yield in H.b. Arch. f.d. Rub. Cult. *5*, 574, 1921.
3. Tapping Experiments. Bull. R. G. A. *6*, 87, 1924.

TABLE II.

Plot A.

GIRTH IN CMS.

	100-120	121-140	141-160	161-180	181-200	201-220	221-240	241
	15	32	38	31	73	45	63	32
		27	30	29	52	44	53	31
Mean yield		22	30	29	52	41	43	
in grams			22	23	51	39	36	
of indivi-			18	23	42	37	33	
dual trees.			17	12	38	25		
			16		26	22		
					21	20		
					20	18		
					19	18		
					16			
Mean of each group.	15	27	24.4	26.5	35.4	30.9	45.6	31.5

Plot F.

GIRTH IN CMS.

	61-80	81-100	101-120	121-140	141-160	161-180	181-200
	8	20	48	36	42	48	46
	7	18	40	33	29		24
		17	37	27	29		
	4	16	33	25	23		
		12	33	24	20		
Mean yield		11	31	22	18		
in grs. of		11	27	19			
individual		10	26	19			
trees.		4	23	11			
		4	20				
			20				
			19				
			19				
			19				
			18				
			18				
			16				
			12				
			11				
			10				
Mean of group.	6.3	12.6	22.8	24	25.7	48	35

Excluding irregularities due to working with small numbers, both sets of figures, if plotted would give curves of the type of the R.G.A. publication, yet, inspection of the tables shows:—

Plot A.—If the eleven smallest trees were removed one good (38) and three fair yielders (32, 30, 30) would be taken and five poor yielders would be left; if the seven largest trees were selected as mother trees, three fair yielders (31, 32, 33) would be included and four high yielders (73, 52, 52, 51) would be omitted.

Plot F.—If the thirteen smallest trees were removed one average yielder (20) would be taken and five (10, 11, 11 12 and 16) poor yielders left; if the nine largest trees were selected, four fair yielders (18, 20, 23, 24) would be included and three high yielders omitted (48, 40 37).

Selection by girth could therefore hardly be regarded as satisfactory either for thinning or breeding. In view of the simplicity of the method of making rough classifications of the yielding capacity of trees and the ascertained approximate relative constancy of yield, there would appear to be little excuse for the absence of yield records from areas of tappable age.

On immature areas thinning has, up to the present, been conducted on appearance (which includes girth) and considerations of space, and no better alternative has yet presented itself.

So far as the writer knows it has not yet been shown that there is a close correlation between girth and latex-ring developing at say, 3 years and that at 5 years, La Rue (loc. cit p. 577) has in fact, brought forward indirect evidence to the contrary. Until such correlation has been shown to exist the usual method of thinning must be realised to be empirical (although necessary) and the selection of high yielders on immature areas by girth measurements to be hazardous.

Yield, an inherent character?

Bryce and Gadd have studied the rates of change of girth latex ring development, bark thickness and yield from one year to the next. Their result are summarised as follows (Bull. No. 68 p.69.)

" The three characters—girth, cortex thickness, and number of
" latex vessel rows—are so interlinked that a change in one is ac-
" companied by a corresponding change in the others. Any increase
" in the rate of growth results in an increase in cortex thickness, num-
" ber of latex vessel rows, as well as in girth. Increase in the rate of

" growth does *not*, however, result in increased yield. Increase in " yield must, therefore, be considered to be independant of the growth " rate."

" Growth and Yield."

" It is not generally recognised that increase in yield is indepen- " dent of increased growth and conversely that increased growth is " not necessarily accompanied by increased yield. These facts are " important in their bearing on estate practice in that methods of " cultivation directed toward encouraging increase in growth do not " necessarily result in increase in yield. Where increase in yield " has occurred following such methods of cultivation, it must be " considered as a direct effect of such treatment on yield, rather than " an indirect effect through any increased growth that may be " induced."

" Estate cultivation consists principally of working the soil " and manuring, and the direct result of this treatment is increased " growth. With regard to other crops, such as tea, coconuts, and " cocoa increased growth thus induced results in bigger crops, but " the nature of the crop is in these cases vastly different to the crop " in the case of rubber. In the case of tea the crop is the leaf, and " the more vigorous the more abundantly leaf is produced. In coco- " nuts and cocoa the crop is the fruit which consists mainly of food " materials manufactured by the leaves. The rubber crop, however, " is derived from the latex, and though the function of the latex is " still unknown, its value to the tree appears to be small, as the loss " occasioned by tapping does not greatly diminish growth. There is " then no apparent connection between latex production and growth. " .....

" It has been shown .....that those trees which during " the course of these investigations have made the greatest percent- " age increases in girth are not in general the trees which have given " the greatest percentage increases in yield, the coefficient of corre- " lation for these characters being + .03 ± .054. If increase in girth is " regarded as a measure of growth activity, then increase in yield " cannot be ascribed to the same cause."

" Of the many manurial experiments carried out on rubber no " one experiment, to the knowledge of the writers, has indubitably " proved that the application of manures has increased the yield of " rubber. That the application of manure increases the growth and " general vigour of the trees is undoubted, as it is possible to distin- " guish manured from unmanured fields at a distance by their gene- " ral appearance, manuring probably promotes also a more rapid " regeneration of the renewing cortex, increase in cortex thickness " being interlinked with increase in girth. Manuring therefore " maintains the general vigour of the trees, but there is no evidence " that it increases the yield."

" These observations lead to the conclusion that yield is inde-
" pendent of vegetative vigour. Yield is an inherent character; a
" tree is, in general, born a good yielder or a bad yielder, and no
" special cultivation or treatment will convert a poor yielder into a
" good yielder. It is possible, however, owing to disease or to un-
" favourable conditions that high yielders may become mediocre or
" even poor. Cultivation in estate practice should, therefore, be
" directed toward the maintenance of the trees in normal conditions
" of health and growth, to enable them to give the greatest yields that
" their inherent character renders possible."

Grantham's more recent publication* has supplied a case in which manuring *has* largely affected yield.

The writer cannot agree that a clear case for yield as predominantly an inherent character has been made out from the observations of the authors quoted. Irrespective of the function, if any, of latex, the all important point would appear to be that " yield " on tapping is an un-natural event and not a function of the tree at all, (a point stressed elsewhere by Bryce and Gadd) as it would be if the bark was destructively extracted for rubber. Actually, Bryce and Gadd have shown that growth results in a proportionate development of latex rings and therefore presumably of rubber *within* the bark. Yield, as an un-natural event, may be expected to be the result of the interplay of a number of factors, some inherent and others accidental.

The result of growth may well be to change some of these factors in a direction favourable to increased yield and others in an adverse direction. To give an example, it seems reasonable to suppose that the cessation of flow of latex is influenced by reduction of pressure in the tree brought about by excess of transpiration over absorption, in which case the flow may cease earlier or later as transpiration is more or less vigorous.† Now a rapid increase of girth may be connected with a rapid increase of leaf surface and vigorous transpiration but a relative lag in absorption, due either to a lag in root development, or more likely, to lack of immediately available water; given such conditions there may be early cessation of flow which may result in stationary yield but increased girth.

It should be clear that the question of the nature of yield is not merely an academic one. If environment early or current, can to an appreciable extent directly modify yield, then increases of yield by beneficial changes of environment should be a possibility on existing areas and the discovery of methods of bringing about such beneficial

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* Grantham Manuring Experiments on Hevea. Arch f. d. Rub Cult *8*, 501, 1924.

†c.f. Sharples, M.A.J. *12*, 315, 1924, who mentions observation that flow continues longer on damp mornings than on dry ones.

changes becomes a problem of even greater importance than it would be if the vigour of the trees alone was concerned.

Double V. Tapping.

Experiments with girdling cuts planned for the Brown Bast Investigation Committee and carried out on Castleton Estate* had shown little damage to the trees provided the interval between tappings was one day or more, while the yield obtained under such conditions was promising. It seemed worth while to continue experiments with long cuts and on plots C. D. E. G & H this was done. For convenience two opposite V-s, each over half the circumference, were used instead of the full spiral.

Plot C.—There were 50 trees tapped on one quarter daily, and 25 trees on a double V twice a week. After more than a year of tapping, yields were still so low that this plot was abandoned. Excluding the wintering period, the mean yield per tapping per tree from the daily tapped trees was 13 ccs., while that from the double V trees was 38 ccs. Taking the number of tappings per year as 350 daily and 100 twice weekly the yearly yield would be 455 ccs and 380 ccs. respectively, while the relative quantity of bark removed would be as 87 : 100 -assuming that the amount removed at each tapping was the same. On this particular and very bad area comparison with alternate day tapping on a single V would probably be more favourable to the double V.

The renewal of bark on the double V trees was better than on the trees tapped daily.

Plot D.—This plot had rather a chequered career. The trees were all tapped for 3 months daily on the double V to establish a basis for comparison, then divided into two groups and tapped for 17 months on the double V once and twice weekly respectively. The two groups were then sub-divided, and alternate trees of the first group tapped weekly on one V and two V-s, while those of the second were tapped twice weekly on one or two V-s.

After 7 months the intervals were reduced and the groups tapped alternate daily and daily respectively for two months.

Renewal has been that normal to this field.

Results were as follows :—

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* Recorded by Sharples and Lambourne in this Journal XII Nos. 9 and 10 1924.

TABLE III.

Plot D.

Date.	Field.	No. of			Yield per task per field.	No. of trees in tapping.	Months in tapping.	Yield per tree per annum (calculated).	Bark* removal (calculated).	Yield per unit of bark removed per annum.
		Tapping System.	Collections.	Total yield in ccs.						
25-4-22 to 13-7-22	No. 1 to 50 -	Daily 2 Vs -	6	11,261	1,875	50	3	13,125	700	18.9
do. -	No. 51 to 100 -	do. -	6	10,394	1,732	50	3	12,724		18.2
13-7-22 to 17-12-23	No. 1 to 50 -	2 Vs weekly -	31	84,959	2,740	50	17	2,740	100	27.4
do. -	No. 51 to 100 -	2 Vs twice weekly	31	65,324	2,107	50	17	4,214	200	21.1
17-12-23 to 22-7-23	No. 1 to 50 odd numbers.	Weekly 1 V -	13	10,518	809	25	7	1,618	50	32.5
do. -	do. even numbers -	Weekly 2 Vs -	13	20,228	1,556	25	7	3,112	100	31.1
do. -	No. 51 to 100 odd -	Twice weekly 1 V -	13	7,428	571	25	7	2,284	100	22.8
do. -	do. even -	Twice weekly 2 Vs.	13	17,233	1,325	25	7	5,300	200	26.0
22-7-24 to 29-9-24	No. 1 to 50 (odd) -	Alternate day 1 V	5	5,481	1,096	25	2	7,884	180	43.8
do. -	do. (even) -	Alt. day 2 Vs. -	5	10,330	2,066	25	2	14,875	360	41.3
do. -	No. 51 to 100 (odd)	Daily 1 V -	5	5,475	1,095	25	2	15,330	350	43.8
do -	do. (even) -	Daily 2 Vs. -	5	10,078	2,015	25	2	28,210	700	40.3

*The 'unit' is taken as the amount removed by tapping once on one V.

Daily tapping as 350 times per annum.
Alternate day 180 " "
Twice weekly 100 " "
Weekly 50 " "

In the case of weekly tapping, the actual amount of bark removed is greater than the calculated.

Plot E.—This plot was tapped for nineteen months twice a week on the double V—half the trees were then tapped on one V only while the remainder were continued on the double V, both groups being tapped twice weekly. As on plot F owing to the poor quantity bark and poor yield, bark consumption was high. Renewal has been the same as on Plot F i. e. fair.

Results of dry rubber determinations are :—

(See Table IV on following page.)

Again it is clear that the long cut has had no special effect. The close approximation of the mean yield per unit of bark removed to that for plot F. (21.49 grs.) tapped alternate daily is noteworthy.

Plot G.—This plot was tapped daily on the Double V for twelve months in an attempt to provide material for the study of incipient brown bast. Unfortunately only one case developed.

The yields of latex and dry rubber were at first similar to those of plots E & F—allowing for bark removed but the concentration of rubber rapidly fell from 35--38% to 19-21% while the volume of latex remained steady. The renewing bark after 10 months showed a number of small burrs which are developing with signs of Brown Bast in the surrounding tissues.

Plot H.—This plot was divided into 5 groups of 200 trees, each group being tapped once every 5 days. The latex was bulked and treated in the usual estate routine.

Results are given in table V.

(See Table V on following page.)

Bark renewal is remarkably good, and the trees have not suffered from bark affections. It will be noted that additional help had to be given to the tapper to enable the latex to be brought to the factory at the usual time.

Bark consumption as may be seen was high, (at the rate of approximately ½ inch per month) due to drying out of the bark between tappings. If drying out is neglected and bark consumption taken at 4/5 that of alternate day single V, the results from plots D and E would give an expectation of 4/5 the yield from alternate day single V —actually, the yield on the latter system from the yield is given at 425—450 lbs. of 1st latex rubber, and the result for September-December 1923 shows that the yield from alternate day tapping is certainly not greater than that from the double V.

This suggests that the longer cut has here had a physiological effect just as it appeared to have on Castleton. Increased duration of flow is a marked characteristic of this plot.

TABLE IV.

Plot A.

Tree No.	Mean of 11 collections 2 spouts.		Mean of 13 collections 2 spouts.	1 spout.
1	71			29
2		181	125	
3	61			31
4		16	10	
5	41			26
6		29	25	
7		108	101	
8	87			28
9		33	43	
10	66			38
11		18	18	
12	53			29
13		101	116	
14	50			22
15		45	43	
16	125			73
17		86	66	
18	17			17
19		35	29	
20	105			94
21		18	14	
22	36			17
23		30	28	
24	18			7
25		11	19	
26	37			21
27		24	14	
28	18			18
29		52	53	
30	29			14
31		73	87	
32	31			13
33		13	12	
34	108			46
35		19	14	
36	30			17
37		31	31	
38	37			10
39		21	11	
40	45			23
41		96	108	
42	63			29
43		33	34	
44	27			13
45		32	31	
46	28			16
47		33	29	
48	50			29
49		55	102	
50	32			13
51		45	40	
52	13			9
53		43	37	
54	58			22
55		23	23	
56	58			16
57		12	13	
58	23			14
59		15	13	
60	10			6
	1417	1331	1289	740
Mean yield per tree	47.2	44.3	42.9	24.6

TABLE V.

Plot H.

Month.	Year.	No. of tapping days.	No. 1 latex dry weight lbs.	Yield per tapping lbs.	Remarks.
April -	1922	15	5	3.5	One cooly only.
May -	,,	30	333	11.1	do.
June -	,,	30	433	14 4	do.
July -	,,	30	482	16.0	do.
August -	,,	30	525	17.5	do.
September -	,,	30	558	16.6	do.
October -	,,	27	472	17.5	do.
November -	,,	24	458	19.2	do.
December -	,,	23	448	19.0	do.
January -	1923	26	457	17.6	do.
February -	,,	23	370	16.1	do.
March -	,,	26	365	14.0	do.
April -	,,	24	339	14.1	do.
May -	,,	21	307	14.6	do.
June -	,,	25	391	15.6	do.
July -	,,	30	420	14.0	do.
August -	,,	22	324	14.7	do.
September -	,,	23	291	12.6	Ordinary tapping round. Experiment Stopped.
October -	,,	26	345	13.2	do.
November -	,,	24	341	14.2	do.
December -	,,	26	420	16.1	do.
January -	1924	28	812	29.0	Experiment contd. 1 extra cooly to collect.
February -	,,	27	750	27.7	do.
March -	,,	29	580	20.0	do.
April -	,,	24	492	20.5	do.
May -	,,	29	621	21.4	do.
June -	,,	28	598	21.3	do.
July -	,,	30	700	23.3	do.
August -	,,	26	551	21.2	do.
September -	,,	27	601	22.2	do.
October -	,,	27	658	24.4	do.
November -	,,	27	655	24.3	do.
December -	,,	29	733	25.2	do.
January -	1925	27	740	27.4	On Jany. 1st 10" tapping surface remaining, 18" having been removed
February -	,,	23	574	24 9	do.
March -	,,	31	728	23.5	Wintering heavily.
April -	,,	29	677	23.3	do.
May -	,,	27	755	27.9	do.
Total yield from 2 Vs -			11,225		
Mean yield per acre per annum -			506		

Other Plots.—Two similar plots were started on other estates, one on 9 year old rubber on flat land gave yields equal to the average of field after a month's tapping and maintained these yields for 6 months.

The other on 5—6 year old rubber on flat land gave very low yields, and the experiment was stopped.

Discussion.—The results given above suggest that there is no commercial future for tapping methods involving long cuts and long intervals; even if there is a compensating increase of flow, drying out leads to too rapid consumption of bark relative to latex obtained.

From the theoretical view point, however, there are indications, but no more than indications, that may be of some importance. Summarised we find that plots D & F on hilly, somewhat washed land gave yields roughly proportional to the length of cut and frequency of tapping—while the yields on Plot H, Castleton, and another estate, all on flat land, strongly the suggested yields under this system were greater than the theoretical.

This would seem, in the first instance, to point to water-supply as a limiting factor in production ; if this can be confirmed by work on these, and other lines, many puzzling problems might be solved, while it is needless to stress the practical results that might follow.

Summary.

The possible connection between a number of factors and yield is discussed.

The question of yield as an inherent or individual character is discussed.

The results of tapping at long intervals with long cuts are given.

Received for publication 18th August 1925.

CALOPOGONIUM MUCUNOIDES.

By J. N. Milsum and E. A. Curtler.

IN Circular No. 4/24 "Cover Plants in Malaya," published by the Department of Agriculture, reference was made to this comparatively new cover plant, and the following notes are written in view of the interest shown in this introduction.

Calopogonium Mucunoides, Desv. is a native of tropical America but has become established on the East Coast of Sumatra and in parts of Java. Its vigorous growth amongst 'lalang' being noticed in Sumatra, a trial was made in 1922 to ascertain its value as a cover crop in young rubber areas in that country (1). Since its employment as a cover plant, Calopogonium has become very popular on estates in Sumatra and has been planted to a less extent in this country. In this connection it is of interest to note that at least two other herbaceous plants indigenous to tropical America have now become widely distributed in the Malay Peninsula, these being the the Sensitive plant, *Mimosa pudica*, and the wild Passion flower, *Passiflora foetida*.

Seed was obtained from Sumatra in September, 1924, by the Department of Agriculture and the observations recorded are based on experience with this plant during a comparatively short period only. Several estates, employing this cover, have been visited and the opportunity taken of observing it, where planted over large areas.

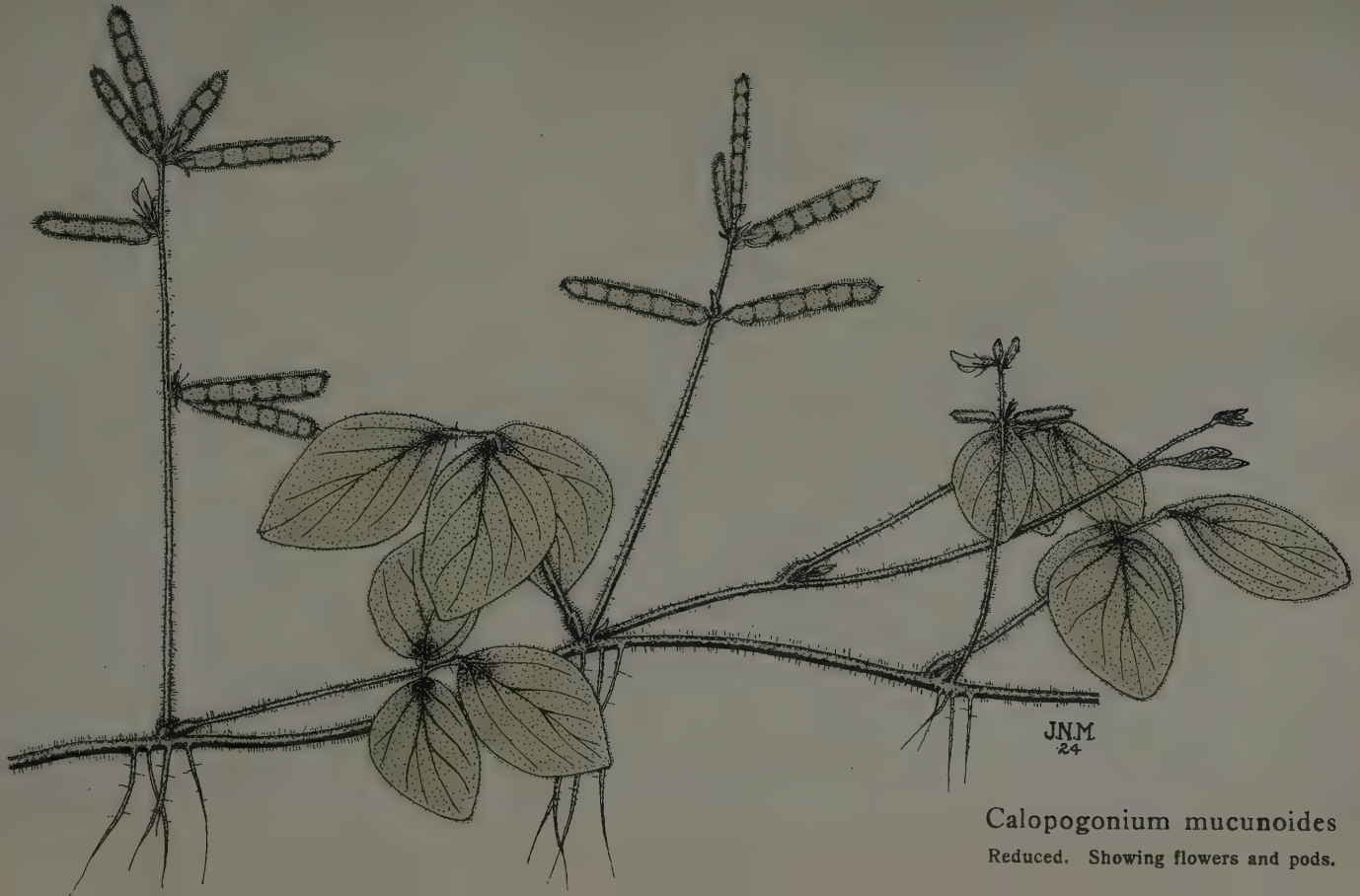
Description.—A vigorous creeping herb, forming a mat of foliage 1½ feet or so in thickness over the soil. The tendrils have a strong twining tendency, ascending in a left hand direction. Length of stems 3 – 10 feet, forming roots below each node, stems succulent, with brown hairs. Stipules triangular, length 2 to 4 millimetres. Leaves trifoliate, leaflets 1 – 5 inches long, 1 – 4 inches broad, hairy on both sides, oval, with round or wedge-shaped base and obtuse apex having a small nerve point. Flowers in racemes, 1 – 4½ inches long covered with brown hairs, small, pale blue, from 4 – 12 on a raceme produced in great profusion. Pod 20 – 40 millimetres long, 4 – 5 millimetres broad, densely covered with brown hairs, 4 – 8 seeds. Seeds small, flattened, brown in colour with thin seed coats. Approximately 33,000 seeds weigh one pound.

According to Keuchenius (2) this legume is known in Java as "Katjang asoe."

Propagation.—Seed may be broadcasted on land that has been lightly changkolled but more satisfactory results are obtained by sowing in rows, about three feet apart. In the latter method about 3

(1) Archief voor de Rubberculture, Mei 1924, p. 200.

(2) Mededeelingen van het Proefstation voor Thee, No. XC.



Calopogonium mucunoides

Reduced. Showing flowers and pods.

lbs. of seed are required to sow an acre. Germination is encouraged by soaking the seeds in warm water immediately before sowing.

On undulating land that has recently been opened and bunded or silt-pitted, good results are obtained by sowing the seeds fairly thickly in lines on the 'spoil' obtained from the pits or on the sides of the bunds. The seeds commence to germinate within 5 days from sowing and in three months the growth is sufficiently strong to assist materially in holding up the soil supporting the bunds or that from the silt pits. As the plants age, the growths spread outwards and become attached to the soil by means of the roots which are thrown out at each node. The plant may be propagated from cuttings but this method is not recommended, as in the field a large percentage of failures occurs owing to the cuttings, which are usually very succulent, drying out.

Habit.—Calopogonium is stated to be intolerant of shade and is useless as a cover plant for old rubber areas. Its value lies in its employment as a wash preventative on newly opened undulating land, planted with such crops as rubber or oil palms. It is also likely to be of permanent value under coconuts, though the writers so far have not seen it used extensively for this purpose. Calopogonium is being used successfully on a small area at Castleton Government Plantation, in the Lower Perak district, planted with ten year old coconut palms. The legume has completely covered the land in six months time from sowing and it appears to thrive well on the alluvial clays of this coastal district. A fair cover is formed after three months from sowing when flowering commences. Seeds are produced within a further three months. By this time a dense luxurious cover is formed, through which few weeds are able to penetrate. The growth does not appear to diminish but remains a dense mass of stems and leaves, resulting in a most effective cover over the soil. In addition the land is kept in a moist condition and enriched with a large amount of humus matter.

Dr. de Jong, Director of the A.V.R.O.S. Experimental Station, Medan, reports a disease attacking Calopogonium in Sumatra but so far this does not appear to be experienced in this country.

The stems of the plant remain succulent and there is unlikely to be any danger of fire occurring during dry weather as has been reported in the case of Giant Mimosa (*Mimosa invisa.*)

The plant is a very profuse seeder and natural reproduction takes place freely where there is sufficient space for the seedlings to thrive.

As far as the writers are aware no seed is harvested for sale at present in this country. Supplies of fresh seed are, however, imported regularly from Sumatra.

Received for publication 11th July 1925.

FORMIC ACID VERSUS ACETIC ACID AS A COAGULANT.

By B. J. Eaton.

OWING to recent interest in and enquiries received concerning the use of formic acid in place of acetic acid as a coagulant for Hevea latex, in the preparation of rubber, the following results and observations on experiments carried out by the writer about ten years ago and published in Bulletin No. 27. "The Preparation and Vulcanisation of Plantation Rubber" (Pages 232—233) may be of value.

The table below, abstracted from the above publication, gives the rate of vulcanisation and tensile figures for samples of fast curing rubber (Slab) coagulated by means of the minimum amount of formic acid (1.5 ozs. of a 5 per cent. solution of formic acid per gallon of standard latex) and also with an excess of the acid equivalent to 33 per cent. above the minimum. For comparison, the figures for a sample coagulated with the minimum amount of acetic acid (approx 3 ozs. of a 5 per cent. solution per gallon of standard latex) are included.

Reference No.	Optimum time of cure. Hours.	Breaking Load (Kilos sq. m.m.) (a)	Elongation at break (Original length=100) (b)	Tensile Product. (a & b)
163.S.1A. ...	1¼	1.50	991	1486
163.S.3B.1 to S.12.B.1.	1—1¼	1.38—1.55	932—1003	1368—1508
163.S.1.B.—S.3.B. ...	1¼	1.43—1.46	957—986	1396—1409

Sample A is the control sample coagulated with acetic acid ; samples B1 (ten samples) are those coagulated with the minimum amount of formic acid ; samples B (three samples) are those coagulated with 33 per cent. excess of formic acid.

The figures show that the rate of vulcanisation of the samples coagulated with formic acid compared with that of the acetic acid coagulated sample (Note.—Many other acetic acid coagulated samples give similar figures) are similar, while the figures for tensile strength are also equivalent.

Formic acid, which is a "weak" organic acid, is not likely to affect adversely the keeping qualities of the rubber or to have any other deleterious effect on the rubber.

It will also be seen that only about half the quantity of formic acid, compared with acetic acid, is necessary.

Results have been published by other investigators which show different proportions of formic acid compared with acetic acid, but

these differences are probably due to the strength of the original formic acid employed. The strength of the formic acid used in the above experiments was determined by titration.

The "technical" or commercial formic acid on the market is frequently below 100 per cent strength—a well known commercial acid sold being of 85 per cent strength, whereas commercial glacial acetic acid is essentially of 100 per cent strength.

The results show that, if formic acid of 100 per cent. strength can be purchased locally at less then twice the cost of acetic acid, it is more economical than acetic acid as a coagulant. An acid of 80 per cent. strength would have to be less than 1.6 times as expensive as acetic acid to render its use economical.

In purchasing formic acid, buyers should first obtain a guarantee of its strength from the sellers. In the case of glacial acetic acid, the term "glacial" is a technical or trade name which indicates that the acid is essentially 100 per cent. No similar term is used, in the case of formic acid, to indicate its strength.

Recent comparative prices quoted for glacial acetic acid, acetic acid (80 per cent.) and formic Acid (85 per cent.) in England are £67, £41 and £48 per ton respectively.

At these prices the formic acid is much more economical than acetic acid.

An interesting point in connection with the above market prices is that glacial acetic acid is more than 50 per cent higher in cost than 80 per cent acetic acid. Even with the extra freight on 20 per cent of water, it would probably be more economical to import 80 per cent acetic acid (pure) into Malaya for estate use, than to continue the importation of the pure glacial acetic acid.

Buyers should however obtain a guarantee of the strength of the acid from sellers.

Received for publication 2nd July 1925.

THE JAMAICAN OR GROS MICHEL BANANA AND THE PISANG EMBUN OF MALAYA.

COMMUNICATIONS have been received by the Department of Agriculture from the West Indies in which it was asked whether the Jamaican or Gros Michel banana is grown in Malaya. These enquiries were made because the Gros Michel variety in those islands is attacked by Panama and other diseases, and efforts were being made to introduce and also to breed strains resistant to disease. It may be mentioned that the Gros Michel variety forms the bulk of the banana export trade from the British West Indies and Central America.

The writer believes that the Malayan Pisang Embun is the same as the Gros Michel banana of the West Indies. Although it has not yet been possible to compare the local and West Indian forms side by side, still from a knowledge of the bananas in both countries, he is of opinion that if they are not identical, they very closely resemble each other.

Fawcett in his book "The Banana, Its Cultivation, Distribution and Commercial Uses" states that "an improvement on the ordinary fruit occurred in Martinique, and eighty years ago M. Jean Francois Pouyat, although he may not have been the first to notice it or the first to propagate it, was yet sufficiently alive to its importance to introduce it into Jamaica. This variety, called at first the Pouyat banana, or the Martinique banana, has become the only one that is cultivated in Jamaica, Costa Rica, and elsewhere for export, and is known now as the Jamaican or Gros Michel banana."

In common with many other Malayan varieties the origin of Pisang Embun is unknown; still, it is unlikely that it was introduced from the West Indies.

The Malays grow another distinct variety of banana which is quite green when ripe and which they term Pisang Embun Lumut or Pisang Masak Hijau—this is sometimes incorrectly referred to as Pisang Embun.

Pisang Embun, which is a variety of Musa sapientum, is grown commonly in native gardens for sale in the local markets. The plants are 15 to 20 feet tall and produce in good soil, large bunches of fruits with 9 to 12 'hands.' Each 'hand' in a bunch is closely packed with 15 to 20 fruits which ripen very evenly. The ripe fruit is 6 to 7½ inches long, 1¼ to 1½ inches in diameter, and bright yellow in colour. It is 3 to 5 angled, but the outer fruits of a 'hand' are, as a rule, more distinctly angled than the inner ones. The skin is tough and fairly thick. The flesh of the fruit is seedless, cream-coloured, sweet and of good flavour and consistency. Rarely a round dark-brown seed

'Pisang' is the Malay word for banana and 'Embun' for dew.

occurs in a fruit; this phenomenon was also noticed by the writer in the Gros Michel variety in the West Indies.

Although the Pisang Embun variety is cultivated in small areas throughout the country and is a favourite market variety no reports of damage done to it by diseases have been received by the Department of Agriculture, still diseases may be present, but owing to the relatively small area planted and the low commercial value of the crop these have not been investigated.

W. N. S.

Received for publication 16th April 1925.

Publications of the Department of Agriculture.

The following publications, except those out of print, may be obtained on application to the Office of the Secretary for Agriculture; and the Malay States Information Agency, 88, Cannon Street, E.C. London.

A remittance to cover the cost should accompany applications; otherwise the Journals will be sent by post, Cash on Delivery, where that system is in force.

1. The Agricultural Bulletin F.M.S.

Vols. I—IV (1913-16) VIII & IX (1920-21) price $5.00 per volume.
Vol. V (1917) Nos. 1, 2, 3, 5 & 6 „ 2.50 per set.
„ VI (1918) „ 1, 7, 8 & 12 „ 2.00 „
„ VII (1919) „ 2—6 „ 4.50 „

2. The Malayan Agricultural Journal (continuing the Agricultural Bulletin). Published monthly.

Vol. X (1922) Price $5.00 per volume.
„ XI (1923) Price $5.00 per volume or 50 cents per single number.
„ XII (1924) „ „ „ „

Back numbers of Vols. I—X will not be sold singly.

3. The Handbook of Malayan Agriculture, price $1.00.

Current numbers of the Malayan Agricultural Journal and the Handbook may be purchased at the Railway Bookstalls and Branches of Messrs. The Federal Rubber Stamp Co.

4. *Special Bulletins.*

1. Notes on *Termes Gestroi* and other species of Termites found on Rubber Estates in the Federated Malay States, by H. C. Pratt, Government Entomologist, 1909, 20 cts.
2. Root Diseases of *Hevea Brasiliensis*, by W. J. Gallagher. C
3. Observations on *Termes Gestroi* as affecting the Para Rubber Tree and methods to be employed against its Ravages, by H. C. Pratt, Government Entomologist, 1910, reprint 1916, 20 cts. (Out of Print.)
4. A Lepidopterous Pest of Coconuts, *Brachartona catoxantha, Hamps*, by H. C. Pratt, 1909. C
5. The Extermination of Rats in Rice Fields, by W. J. Gallagher, 1909. C
6. Preliminary note on a Branch and Stem Disease of *Hevea Brasiliensis*, by W. J. Gallagher, 1909. C
7. Coffea Robusta, by W. J. Gallagher, Government Mycologist, 1910, 20 cts.
8. The Cultivation and Care of the Para Rubber Tree (in Malay) 1910. C
9. Die-Back Fungus of Para Rubber and of Cacao, by K. Bancroft, 1911. C
10. A Lecture on the Para Rubber Tree, by W. J. Gallagher, 1910. C
11. Coconut Cultivation, by L. C. Brown, 1911. C
12. Padi Cultivation in Krian, by H. C. Pratt, 1911. C
13. A Root Disease of Para Rubber, *Fomes Semitostus*, by K. Bancroft, Assistant Mycologist 1912, 20 cts.

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